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USACE / NAVFAC / AFCEC	**UFGS-23 52 43.00 20 (May 2015)**
	Change 2 - 08/18

Preparing Activity: NAVFAC	**Superseding**
	UFGS-23 52 43.00 20 (July 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025

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SECTION 23 52 43.00 20

LOW PRESSURE WATER HEATING BOILERS (UNDER 800,000 BTU/HR OUTPUT)

05/15, CHG 2: 08/18

****

NOTE: This guide specification covers the requirements for low pressure hot water heating boilers under 235 kilowatt 800,000 BTU/hr output.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature

to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.13/CSA 4.9	(2022) Gas-Fired Low Pressure Steam and Hot Water Boilers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPVC SEC IV	(2017) BPVC Section IV-Rules for Construction of Heating Boilers
ASME CSD-1	(2021) Control and Safety Devices for Automatically Fired Boilers

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM C592	(2024) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)

NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS (NBBI)

NBBI NB-23 PART 1	(2013) National Board Inspection Code - Part 1 Installation

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2021) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2024; TIA 23-1) Standard for the Installation of Oil-Burning Equipment
NFPA 54	(2024) National Fuel Gas Code
NFPA 70	(2023; ERTA 1 2024; TIA 24-1) National Electrical Code
NFPA 211	(2019) Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

UL SOLUTIONS (UL)

UL 296	(2017; Reprint Nov 2022) UL Standard for Safety Oil Burners
UL 726	(1995; Reprint Sep 2024) UL Standard for Safety Oil-Fired Boiler Assemblies
UL 795	(2016; Reprint May 2022) UL Standard for Safety Commercial-Industrial Gas Heating Equipment

1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

1.3 DESIGN REQUIREMENTS

****

NOTE: Insert boiler output capacity or indicate in boiler schedule. Select boiler design working pressure, operating pressure, operating temperature, and return water temperature and indicate in boiler schedule on drawings.

****

Boiler must be suitable for installation in the space shown with ample room for opening doors and cleaning and removal and replacement of tubes. Boiler must have an output of [_____] kW BTU/hr. Boiler must be designed and tested in accordance with ASME BPVC SEC IV, ASME CSD-1, NFPA 54, NFPA 31, NFPA 70 and ANSI Z21.13/CSA 4.9. Boiler must be installed in accordance with NBBI NB-23 PART 1. Paint boiler in accordance with manufacturer's recommendations. Boiler design working pressure must be [207 kPa (gage)] [30 psig] [_____]. Boiler operating pressure must be [83 kPa (gage)] [12 psig] [_____]. Boiler operating temperature must be [82 degrees C] [180 degrees F] [_____]. Boiler return water temperature must be [71 degrees C] [160 degrees C] [_____]. Provide a thermostatically controlled three-way mixing valve on boiler suitable for operating conditions of the boiler.

1.3.1 Boiler Installation Requirements

1.3.1.1 Location

Install Boiler(s) and associated hot water pumps in a mechanical room inside the facility in accordance with NBBI NB-23 PART 1. Provide ample clearance around boilers to allow access for inspection, maintenance and repair. Passageways around all sides of boilers must have an unobstructed minimum width of 36 inches or the clearances recommended by the boiler manufacturer whichever is greater.

1.3.1.2 Combustion Air

Provide supply of air for combustion and ventilation. In accordance with NFPA 54, NFPA 211 and manufacturer's installation manual, calculate the amount of combustion air necessary to operate the boiler. Install and locate properly sized combustion air dampers and louvers.

1.3.1.3 Sequence of Operation

Local, manual starting of boilers is required. Remote starting and stopping of the boiler by the HVAC control system is not permitted. This is to ensure that an operator witness the initial firing of the boiler at the beginning of each heating season to verify proper operation of the boiler and to promote proper maintenance.

1.3.2 Detail Drawings

1.3.2.1 Drawings

Show boiler hot water isolation valves, emergency disconnect switch, and complete boiler gas train on the contract drawings.

1.3.2.2 Fuel Train / Wiring Diagram

Submit fuel train and wiring diagram.

1.3.3 Water Analysis

Provide test reports of water analysis. UFC 3-240-13FN Industrial Water Treatment must be followed for all boiler installations.

1.4 SAFETY STANDARDS

Hot water boilers, burners and supplementary control devices, safety interlocks, or limit controls required under this specification, must meet requirements of the following standards as applicable:

a. Oil-Fired Units: UL 726, NFPA 31, NFPA 70, ASME CSD-1.

b. Gas-Fired Units: ASME CSD-1, NFPA 54, NFPA 70, ANSI Z21.13/CSA 4.9 or UL 795.

c. Combination Gas- and Oil-Fired Units: ASME CSD-1, NFPA 54, NFPA 31, NFPA 70, UL 726, ANSI Z21.13/CSA 4.9, UL 795 or UL 296.

d. All Units: ASME BPVC SEC IV, NFPA 70 and ASME CSD-1.

Controls not covered by the above must have a UL label, UL listing mark, or must be listed in the Factory Mutual Approval Guide.

1.5 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that

require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

[Submittals for this Section must be delivered to the project Contracting Officer, who will forward two complete sets of copies to the appropriate approving official for review and approval.

] SD-02 Shop Drawings

Fuel Train

Wiring Diagram

SD-03 Product Data

Boilers

[Energy Star Label for Gas Fired Residential Boiler Product; S

][Energy Star Label for Oil-Fired Residential Boiler Product; S

] Boiler Trim and Control Equipment

Burners and Control Equipment

Stack, Breeching, and Supports

SD-06 Test Reports

Operational Tests

Water Analysis

SD-07 Certificates

Boilers

Burners and Control Equipment

Boiler Trim and Control Equipment

Boiler manufacturer's certificate of boiler performance including evidence that the burners provided must be a make, model, and type certified and approved by the manufacturer of the boiler being provided.

SD-08 Manufacturer's Instructions

Boilers

Feedwater Treatment Feeder

SD-10 Operation and Maintenance Data

Boilers, Data Package 4

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Posted Operating Instructions for Heating Water Boilers

PART 2 PRODUCTS

2.1 BOILERS

****

NOTE: Select options based on fuel source, residential or commercial application, and boiler capacity. Efficiencies included below are based on Energy Star for residential applications and ASHRAE 90.1 for commercial applications.

****

Provide hot water heating boiler complete with firing equipment, combustion chamber, insulation with steel jacket, safety and operating controls, integral electrical wiring and other appurtenances, to make the boiler a complete, self-contained, fully-automatic unit, ready for service upon completion of utility connections.[Gas fired residential boilers less than 88 kW 300,000 Btuh must have an Annual Fuel Utilization Efficiency (AFUE)of at least 90 percent, and be Energy Star labeled. Provide proof of Energy Star label for oil-fired residential boiler product.][Oil-fired residential boilers less than 88 kW 300,000 Btuh must have an Annual Fuel Utilization Efficiency (AFUE) of at least 87 percent, and be Energy Star labeled. Provide proof of Energy Star label for gas fired residential boiler product.][Commercial boilers less than 88 kW 300,000

Btuhmust have an Annual Fuel Utilization Efficiency (AFUE) of at least 80 percent.][Gas fired boilers greater than 88 kW 300,000 Btuh input must have a thermal efficiency of at least 80 percent when fired at the maximum and minimum capacities which are provided and allowed by the controls.][Oil-fired boilers greater than 88 kW 300,000 Btuh output must have a thermal efficiency of at least 82 percent when fired at the maximum and minimum rated capacities which are provided and allowed by the controls.]

2.1.1 General Requirements

Design, construction, installation, testing, and operation of boiler and appurtenances must comply with NBBI NB-23 PART 1, ASME BPVC SEC IV, ASME CSD-1, NFPA 54, NFPA 31, ANSI Z21.13/CSA 4.9, and the manufacturer's instructions.

2.2 BURNERS AND CONTROL EQUIPMENT

****
NOTE: Indicate fuel trains on the drawings.
Conform to the requirements of ASME CSD-1.
****

[2.2.1 Atmospheric-Type Gas Burner

Atmospheric-type gas burner (under 117 kW 400,000 BTU/hr input). ASME CSD-1 and ANSI Z21.13/CSA 4.9. Automatic recycling burner. ON-OFF type combustion control system.[Interrupted] [Intermittent] pilot type ignition system, and pilot must be electrode-ignited natural gas type. Design burner and combustion control equipment for firing natural gas having a specific gravity of [0.6] [_____] and a heating value of approximately [37,300 kJ per cubic meter] [1000 BTU per cubic foot] and be an integral part of the boiler. Burner controls and safety equipment must conform to applicable requirements of ASME CSD-1 and ANSI Z21.13/CSA 4.9, including complete gas shut-off and pilot gas. Gas pressure available: [[_____] inches of water gage (WC)] kPa gage psig.

][2.2.2 Gas-Fired Power Burner

Gas-fired power burner (over 117 kW 400,000 BTU/hr input). Interrupted pilot type ignition system, and pilot must be the electrode-ignited natural gas type. Design burner and combustion control equipment for firing natural gas having a specific gravity of [0.6] [_____] and a heating value of approximately [37,300 kJ per cubic meter] [1000 BTU per cubic foot] [_____] and be an integral part of the boiler. Burner controls and safety equipment must conform to applicable requirements of ASME CSD-1, NFPA 54, ANSI Z21.13/CSA 4.9 and UL 795. Mount controls; including operating switches, indicating lights, gages, alarms, motor starters, fuses, and circuit elements of control systems on a single control panel or cabinet designed for separate mounting not on the burner. The combustion control system must be the [on/off] [high-low-off] [positioning] [metering] type. Locate flame scanner such that testing and cleaning of scanner can be accomplished without disassembly of burner. Provide fuel train as indicated. Gas pressure available: [[_____] Pa inches of water gage] [[_____] kPa (gage) psig].

][2.2.3 Oil-Fired Power Burner

Oil-fired power burner (under 117 kW 400,000 BTU/hr input). Direct electric-spark-ignited type ignition system. Burner controls and safety

equipment must conform to applicable requirements of ASME CSD-1, NFPA 31 and UL 726. The combustion control system must be the [on/off] [high-low-off] [positioning] [metering] type.

][2.2.4 Oil-Fired Power Burner

Oil-fired power burner (over 117 kW 400,000 BTU/hr input). Pressure-atomizing type burner. Direct electric-spark-ignited type ignition system. Design burner and combustion control equipment for firing commercial grade number 2 fuel oil and be an integral part of the boiler. Burner controls and safety equipment must conform to applicable requirements of ASME CSD-1, NFPA 31 and UL 726. The combustion control system must be the [on/off] [high-low-off] [positioning] [metering] type. Mount controls; including operating switches, indicating lights, gages, alarms, motor starters, fuses, and circuit elements of control systems on a single control panel or cabinet designed for separate mounting not on the burner. Locate flame scanner such that testing and cleaning of scanner can be accomplished without disassembly of burner. Provide fuel train as indicated.

][2.2.5 Gas and Light Oil-Fired Power Burner

Gas and light oil-fired power burner (over 117 kW 400,000 BTU/hr Input). The combustion control system must be the [on/off] [high-low-off] [positioning] [metering] type. Pressure-atomizing type oil burner. Interrupted-pilot type ignition system, and pilot be electrode-ignited natural gas type, except that the oil burner be direct electric-spark-ignited. Design burner and combustion control equipment for firing commercial grade number 2 fuel oil and natural gas having a specific gravity of [0.6] [_____] and a heating value of approximately [37,300 kJ per cubic meter] [1000 BTU per cubic foot] [_____] and be an integral part of boiler. Burner controls and safety equipment must conform to applicable requirements of ASME CSD-1, NFPA 31, UL 726, NFPA 54, ANSI Z21.13/CSA 4.9 and UL 795. Mount controls; including operating switches, indicating lights, gages, alarms, motor starters, fuses, and circuit elements of control systems on a single control panel or cabinet designed for separate mounting not on the burner. Locate flame scanner such that testing and cleaning of scanner can be accomplished without disassembly of burner. Provide fuel train as indicated. Gas pressure available: [[_____] Pa inches of water gage] [[_____] kPa (gage) psig].

]2.3 BOILER TRIM AND CONTROL EQUIPMENT

Provide in accordance with ASME CSD-1 and ASME BPVC SEC IV and additional requirements specified below.

2.3.1 Emergency Disconnect Switch

****
NOTE: Indicate location of emergency disconnect switch on drawings. Insert emergency switch amperage required.
****

Provide and locate on wall outside boiler room entrance or just inside door, when boiler room door is on building exterior as required by ASME CSD-1 to allow rapid and complete shutdown of the boiler in the event of an emergency. Emergency switch must be a [_____]-amp. fuse-type safety switch. Switch must be red and furnished with a label indicating function

of switch.

2.3.2 Relief Valves

Provide relieving capacity for the full output of boiler installed. Safety relief-valve piping must conform to ASTM A53/A53M, schedule 40 steel pipe and be piped full-size [to a floor drain] [to 150 mm 6 inches above floor].

2.3.3 Pressure and Altitude Gage or Combination Pressure/Altitude Gage

Provide one located on supply water piping and one on return water piping.

2.3.4 Thermometer

Provide thermometer with a scale equivalent to 1.5 times outlet water temperature. Provide one located on supply water piping and one on return water piping.

2.3.5 Drain Tapping

Provide drain valve and piping [to a floor drain] [to 150 mm 6 inches above floor].

2.3.6 Make-up Water Station

2.3.6.1 Pressure Reducing Station

****
NOTE: Select operating pressure required.
****

Provide a water pressure-reducing valve and relief valve, or a combination of the two in the makeup water line to the boiler to maintain a water pressure of [83 kPa (gage)] [12 psig] [_____] in the hot water system. Provide a 20 mm 3/4 inch globe valve by-pass around this valve.

2.3.6.2 Backflow Preventers

Section 22 00 00 PLUMBING, GENERAL PURPOSE. Locate upstream of by-pass.

2.3.7 Feedwater Treatment Feeder

Provide floor mounted, Type II - Shot-Type Feeder (manual, intermittent feed), as indicated for use with pressures up to 1379 kPa (gage) 200 psig maximum.

2.3.8 Combustion Regulator

Provide adjustable temperature, thermostatic immersion type that must limit boiler water temperature to a maximum of 121 degrees C 250 degrees F. Control must actuate burner through an electric relay system to maintain boiler water temperature within normal prescribed limits at loads within rated capacity of boiler.

2.3.9 Air Vent Valve

Provide with screwed connection, stainless steel disk, and stainless steel seats to vent entrapped air.

2.3.10 High Temperature Limit Switch

****
NOTE: Specify alarm and indicating lights if input exceeds 117 kW 400,000 BTU/hr.
****

Provide adjustable immersible aquastat type with a temperature setting above that of the combustion regulator and below that of the lowest relief valve setting. Aquastat must function to cause a safety shutdown by closing fuel valves[,] [and] shutting down burner equipment [, activating a red indicating light, and sounding an alarm] in the event that boiler water temperature rises to the high temperature limit setting. A safety shutdown due to high temperature must require manual reset before operation can resume and prevent recycling of burner equipment. Pre-set high temperature limit devices that cannot be easily tested are not allowed.

2.3.11 Low Water Level Cutoff Switch

****
NOTE: Specify alarm and indicating lights if input exceeds 117 kW 400,000 BTU/hr.
****

Low water level cutoff must cause a safety shutdown by closing fuel valves[,] [and] shutting down burner equipment [, activating a red indicating light, and sounding an alarm] in the event that water level drops below the lowest safe permissible water level established by the boiler manufacturer and ASME BPVC SEC IV. A safety shutdown due to low water must require manual reset before operation can resume and prevent recycling of burner equipment.

2.3.12 Boiler Safety Control Circuits

****
NOTE: Include draft fan if power burner is specified.
****

Provide boiler safety control circuits, including control circuits for burner [and draft fan], must be single-phase, two-wire one-side grounded, and not over 120 volts. Provide safety control switching in ungrounded conductors. Provide overcurrent protection. In addition to circuit grounds, ground metal parts which do not carry current to a grounding conductor.

2.3.13 Indicating Lights

****
NOTE: Delete entire paragraph if boiler input does not exceed 117 kW 400,000 BTU/hr. Include draft fan if power burner is specified.
****

Each safety interlock requiring a manual reset must have an individually labeled red indicating light. Non-recycling control interlocks must have the reset located on the control itself. Red indicating lights on the

control panel may be omitted if the burner combustion control system has a Keyboard Display Module installed that will identify the lockout information required in Item c. below. Indicating lights must have colors as follows:

a. Amber: Ignition on

b. Green: Main fuel safety shut-off valves open

c. Red (One for Each): Safety lockout, flame failure, low water level, and high temperature

[d. Blue: Draft

]2.3.14 Alarm Bell

****
NOTE: Delete entire paragraph if boiler input does not exceed 117 kW 400,000 BTU/hr.
****

Provide alarm bell, electrically operated, with a manual disconnect switch. Disconnect switch must be type and wired so that switching off alarm following a safety shutdown will not prevent alarm from sounding again upon recurrence of a subsequent safety shutdown condition.

2.3.15 Post-Combustion Purge

****
NOTE: Delete entire paragraph if atmospheric burner is specified.
****

Provide controls and wiring necessary to ensure operation of draft fan for a period of not less than 15 seconds or of sufficient duration to provide four complete air changes in the boiler combustion chamber (whichever is greater) following shutdown of burner upon satisfaction of heat demand and in accordance with ASME CSD-1 . Upon completion of post-combustion purge period, draft fan must automatically shutdown until next restart.

2.3.16 Draft

Comply with boiler manufacturer's recommendations.

2.3.17 Stack, Breeching, and Supports

****
NOTE: NFPA 211, Type B vent can only be used with an atmospheric burner.
****

****
NOTE: Boiler stacks must conform to the boiler manufacturer's installation and operational manual.
****

[Provide boiler stack constructed of sheet steel having a thickness of not less than 2.47 mm 0.0972 inches with welded joints. Insulate stack located inside the building with 38 mm 1 1/2 inches of mineral wool

conforming to applicable requirements of ASTM C592, Class II - for use up to 649 degrees C 1200 degrees F. Insulation must receive a finish coat of finishing cement not less than 19 mm 3/4 inch thick, trowelled to a smooth finish. Provide stack supports, umbrella collar and cap, and flue transition piece. Stack diameter and height must be in accordance with manufacturer's recommendations and conform to NFPA 211.]

[NFPA 211, [Type B - gas] [Type L - oil and gas/oil], prefabricated multi-wall type, flashed to the roof, and complete with rain cap. Stack diameter and height must be in accordance with manufacturer's recommendations and conform to NFPA 211.]

2.3.18 Hot Water Coils

****
NOTE: Delete entire paragraph unless hot water coils are required to instantaneously heat domestic water.
****

Provide coils capable of heating [_____] L/s GPM of water with [_____] degree C F rise conforming to ASME BPVC SEC IV.

2.3.19 Stack Thermometer

Provide flue gas dial type thermometer with scale calibrated from 66 to 399 degrees C 150 to 750 degrees F and mounted in flue gas outlet.

2.4 ELECTRIC MOTORS

Electric motors must meet requirements of NEMA MG 1. Motors less than 3/4 kW 1 hp must meet NEMA High Efficiency requirements. Motors 3/4 kW 1 hp and larger must meet NEMA Premium Efficiency requirements. Motors which are an integral part of the packaged boiler system must be the highest efficiency available by the manufacturer of the packaged boiler. Motors must be variable speed.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Install equipment in accordance with manufacturer's installation instructions and NBBI NB-23 PART 1. Grout equipment mounted on concrete foundations before installing piping. Install piping in such a manner as not to place a strain on equipment. Do not bolt flanged joints tight unless they match. Grade, anchor, guide, and support piping without low pockets. Feedwater treatment feeders must be mounted so that the top of the feeder is no higher than 1219 mm 48 inches above the finished floor.

3.2 EQUIPMENT FOUNDATIONS

Locate equipment foundations as indicated, designed, and made of sufficient size and weight to preclude shifting of equipment under operating conditions or under abnormal conditions that could be imposed upon the equipment. Foundations must meet requirements of the equipment manufacturer. Concrete and grout must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.3 BOILER CLEANING

Before being placed in service, boiler must be boiled out for a period of 24 hours at a pressure not exceeding 83 kPa (gage) 12 psig. Solution to be used in the boiler for the boiling out process must consist of two pounds of trisodium phosphate per 379 liters 100 gallons of water. Upon completion of boiling out, flush out boiler with potable water, drain, and charge with chemically treated water. Protect boiler and appurtenances against internal corrosion until testing is completed and boiler is accepted. Professional services are required for cleaning/treatment process.

3.4 FIELD QUALITY CONTROL

Perform and furnish everything required for inspections and tests as specified herein to demonstrate that boiler and auxiliary equipment, as installed, are in compliance with contract requirements. Start-up and operate the system. During this time, clean strainers until no further accumulation of foreign material occurs. Exercise care to minimize loss of water when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence. Test instrumentation must be calibrated and have full scale readings from 1.5 to 2 times test values.

3.4.1 Operational Tests

Furnish the services of an engineer or technician approved by the boiler manufacturer of installation, startup, operational and safety testing. This person must remain on the job until each boiler has been successfully operated. Furnish and perform everything required for inspections and tests of the boiler and auxiliary equipment. Test instrumentation must be calibrated and have full-scale reading from 1.5 to 2 times test values. Demonstrate proper operability of combustion control, flame safeguard control and safety interlocks. Provide a detailed description of all boiler startup and operational tests in the Commissioning Plan.

3.4.1.1 Preliminary Operational Test

Operate the boilers continuously for a period of at least 8 hours to demonstrate proper operability of the combustion control, flame safeguard control, and safety interlocks.

3.4.1.2 Acceptance Operational Test and Inspection

****
NOTE: Insert the appropriate Facility Engineering Command Acceptance Operational test and inspection by NAVFAC Boiler Inspector only required for boilers with capacity of 400,000 Btu/hr or greater.
****

Prior to requesting an acceptance test, conduct a satisfactory operational test for at least 8 hours, and provide a certified statement that the equipment is installed per all requirements of this guide. Contracting Officer, upon receipt of the notice from the Contractor, will request a boiler inspection by a Naval Facilities Engineering and Expeditionary Warfare Center (EXWC) NAVFAC boiler inspector. Fifteen days advance notice is required for scheduling inspector to conduct acceptance operational test and inspection.

3.5 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurements commonly agreed on by the manufacturers or other parties. The inch-pound and metric measurements shown are as follows:

Products	Inch-Pound	Metric
a. Alarm Bell Diameter	= 4 inches	= 100 mm
b. Stack Thermometer Scale Range	= 150-750 degrees F	= 66-399 degrees C

-- End of Section --